

Connecting Development & End of Line in Loudspeaker Measurements 結合開發與線上測試

(Assessing the Quality of Loudspeakers)
評估揚聲器質量

ALMA symposium Shanghai 2006

KLIPPEL GmbH



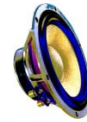
研發 – 品管的循環 The R&D – QC life cycle



試聽
Listener



揚聲器系統
System
(音箱, 分音器, 聆聽環境)



驅動器單元
Driver
(Re, fs, Q)



零件 Parts
(鼓紙, , motor parts)

音質
Sound Quality



轉移特性
Transfer Function



參數
Parameter



幾何形狀,
材料
Geometry,
Material

產品目標
Product Target

模擬解決方案 Simulate Solution

生產測試
Production
Test

原型樣品的實現及測試 Realize & Testing the Prototype

...我們如何支援你 - how we can support you?



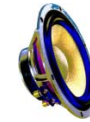
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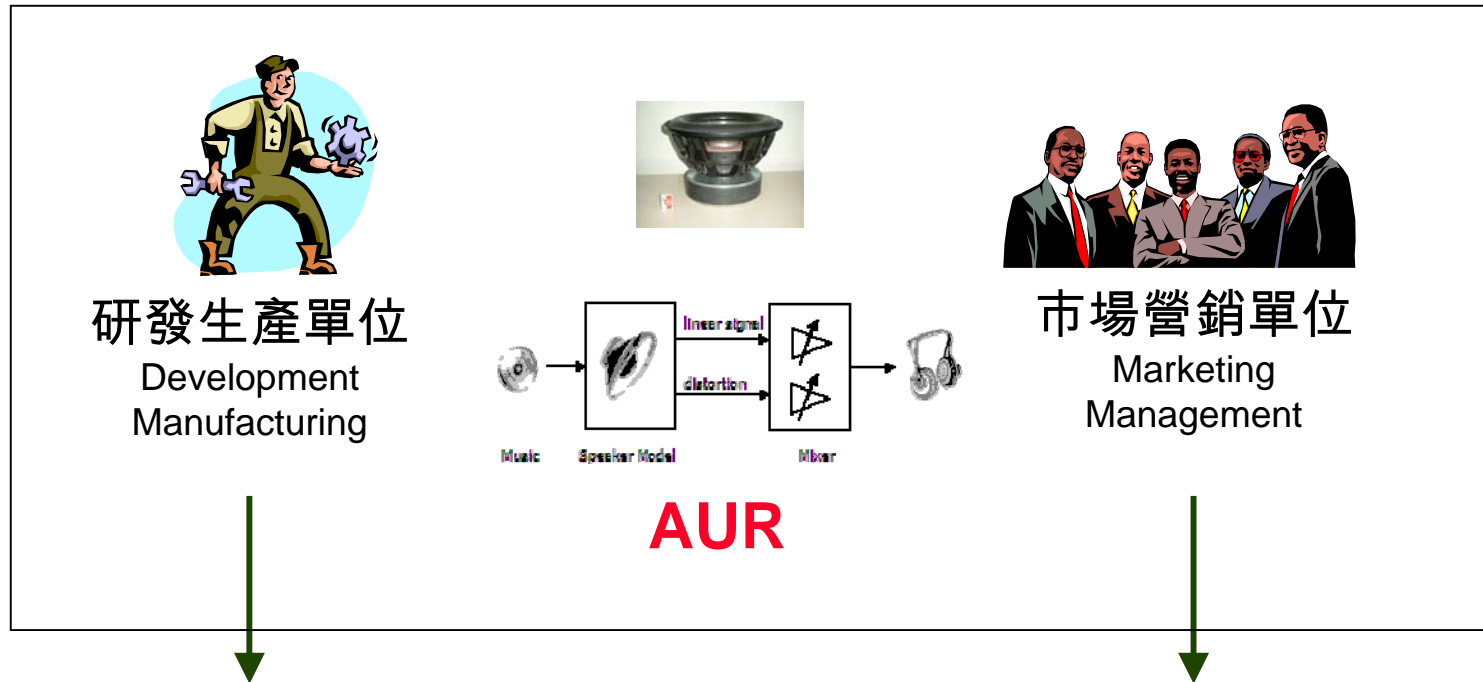
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揚聲器之主觀及客觀評價

Auralization in Loudspeaker Development



客觀評價 Objective Evaluation

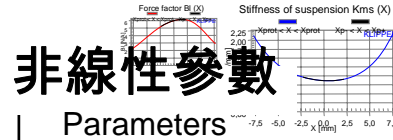
- 失真, 最大輸出 Distortion, Maximal Output
- 振動模式, 溫昇模式 Displacement, Temperature
- 設計選擇的評估 Evaluation of Design Choices
- 指出改進方向 Indications for Improvements

主觀評價 Subjective Evaluation

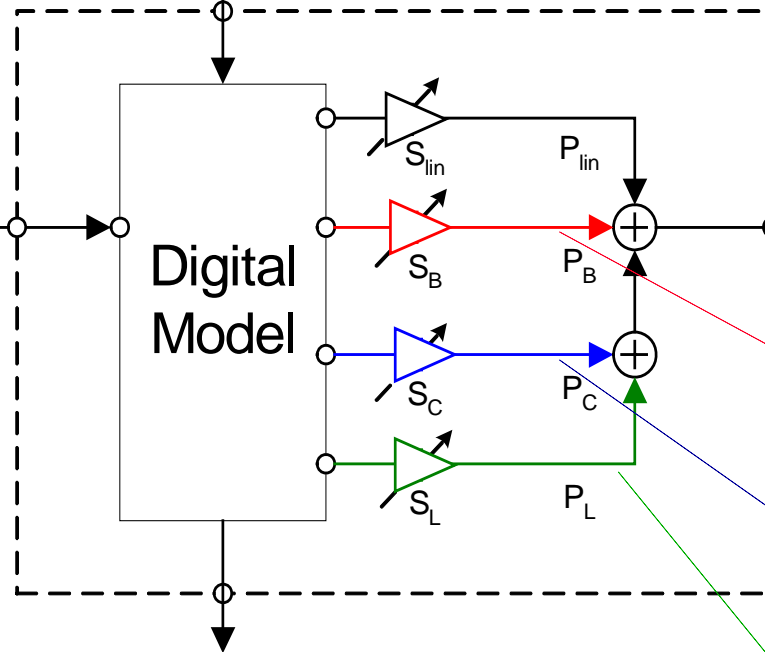
- 個人印象 Personal Impression
- 必要的音質 Sufficient Sound Quality
- 進入主要目標市場 Tuning to the Target Market
- 效益及成本比 Performance/Cost Ratio

各種失真模式之聆聽測試

Listening into a Digital Model



測試音樂信號
Music, test signals



音壓輸出

Sound pressure output

磁迴失真

Motor Distortion

懸吊失真

Suspension Distortion

電感失真

Inductance Distortion

振動模式, 電流, 功率, 溫度

Displacement, Current, Power, Temperature

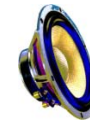
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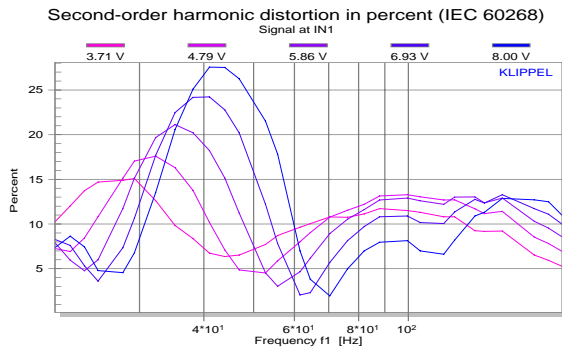
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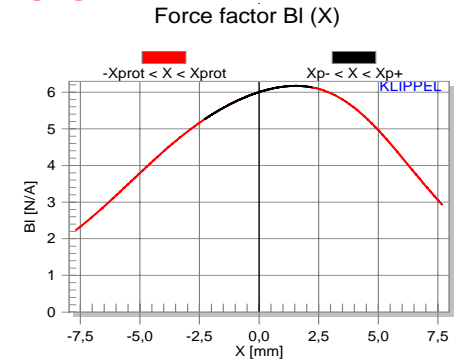
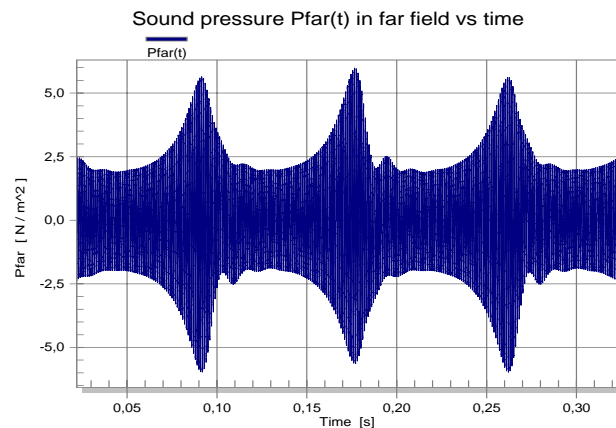


SIM 模擬模塊的結果 provides

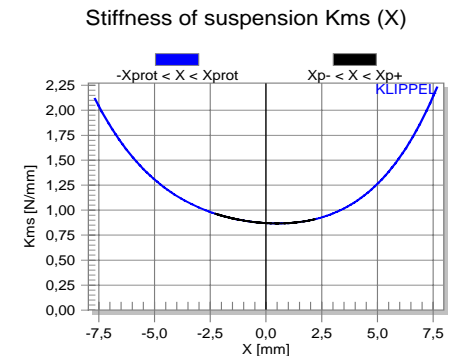
交互關係 Relationship between



大信號參數
Distortion and

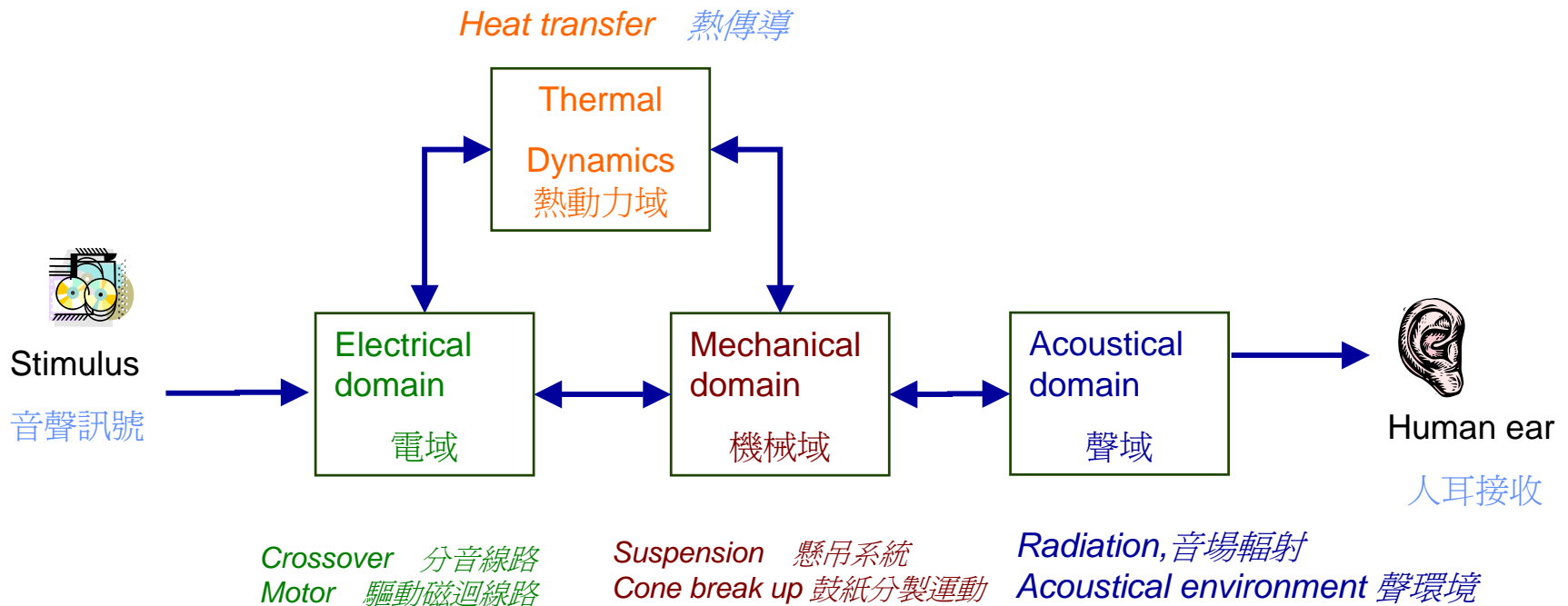


與失真 Large
Signal Parameters



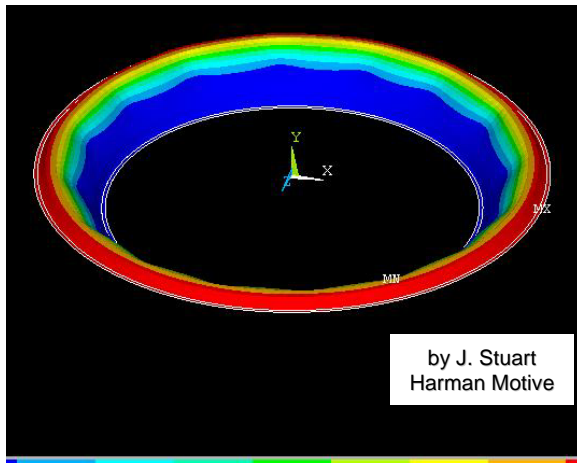
SIM – Connecting Domains

連接不同領域的揚聲器工作

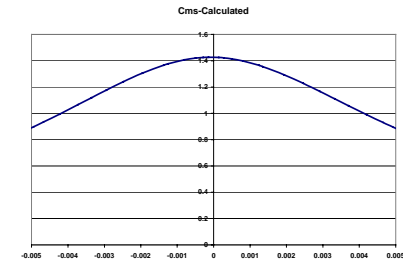


FEA機械有限元素分析輸出

Output of mechanical FEA



結果 Results:

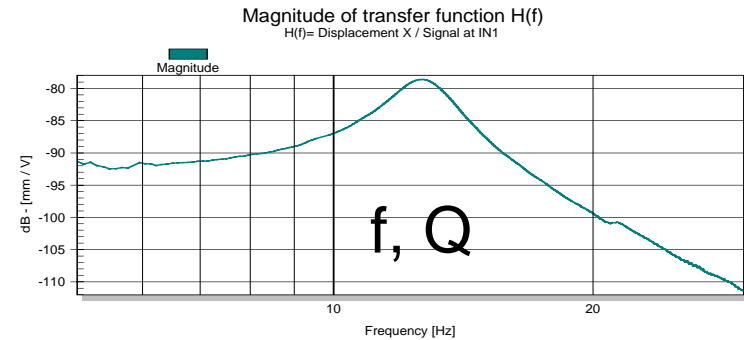


非線性順性
Nonlinear
compliance $C_{ms}(x)$



Measurement of Material Parameters

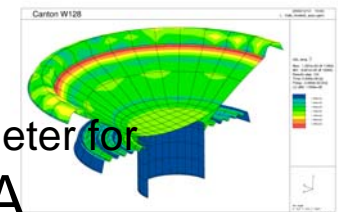
材料本身的參數測量



Young's E modulus
Loss factor η

測得揚氏模量, 損耗因數

Input parameter for
FEA



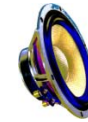
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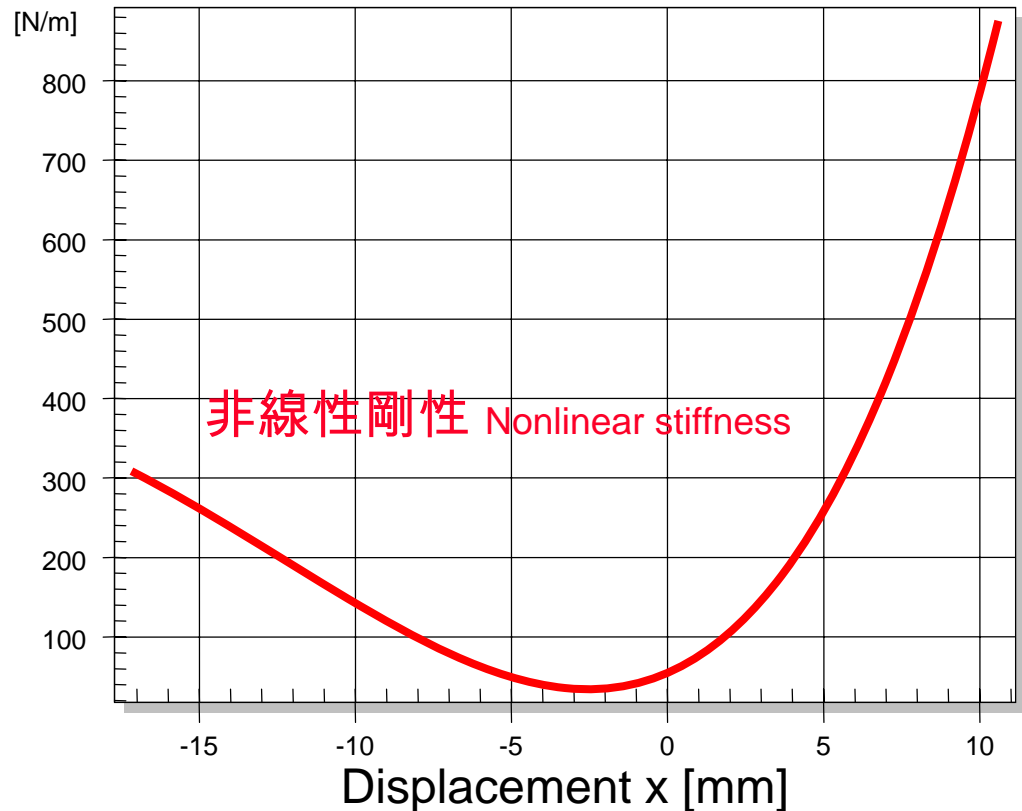
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懸吊系統機械剛性動態測量

Dynamic Measurement of the Mechanical Stiffness of Suspension Parts (SPM)



線性參數測量 LPM

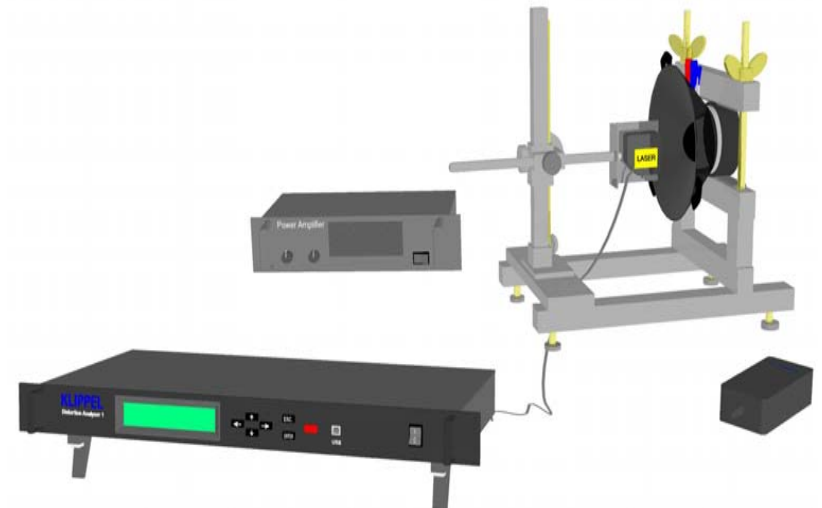
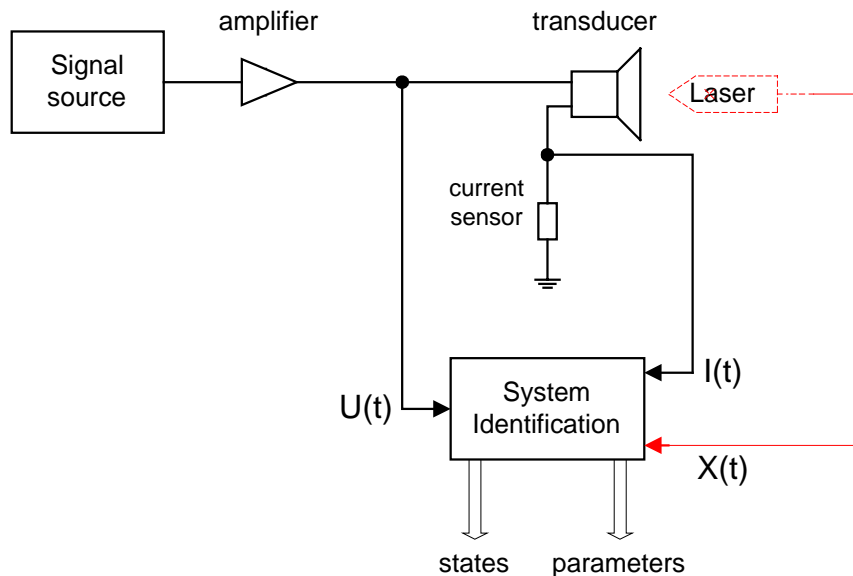
Linear Parameter Measurement

結果 Results:

- Thiele/Small TS 線性參數
(F_0 , Q_{ts} , V_{as} , etc)

- 免附加質量, 附加音箱,

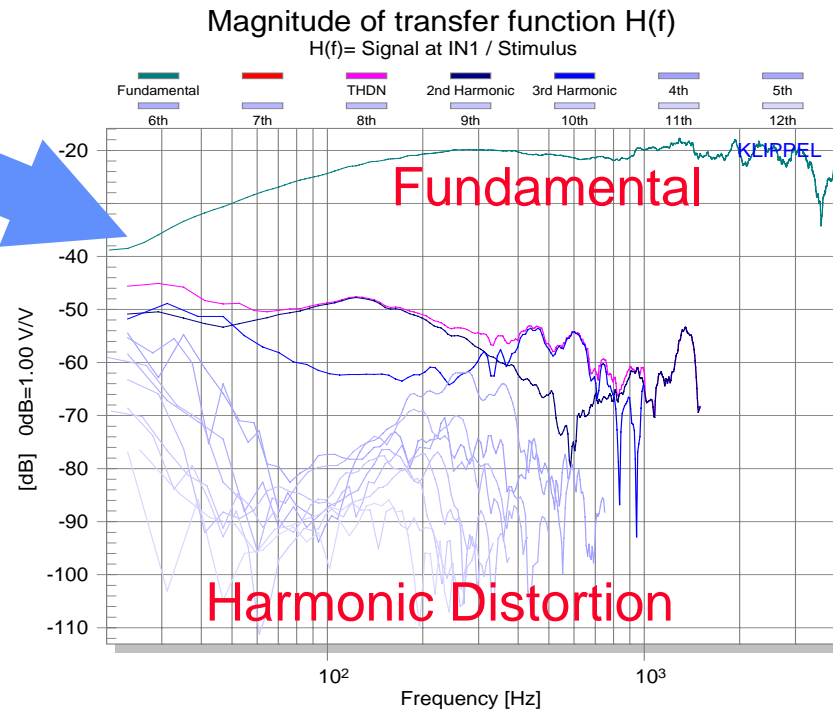
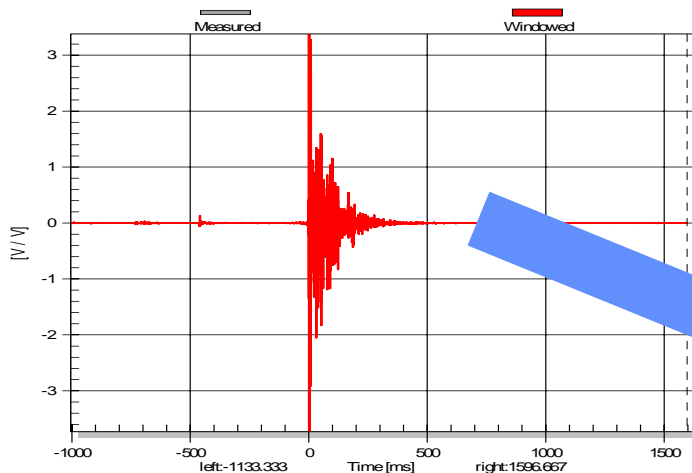
單一測量 Single Measurement



轉換模式以描述線性行為 TRF

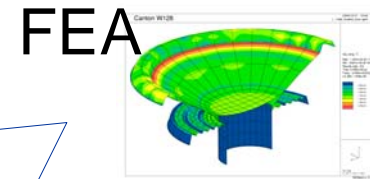
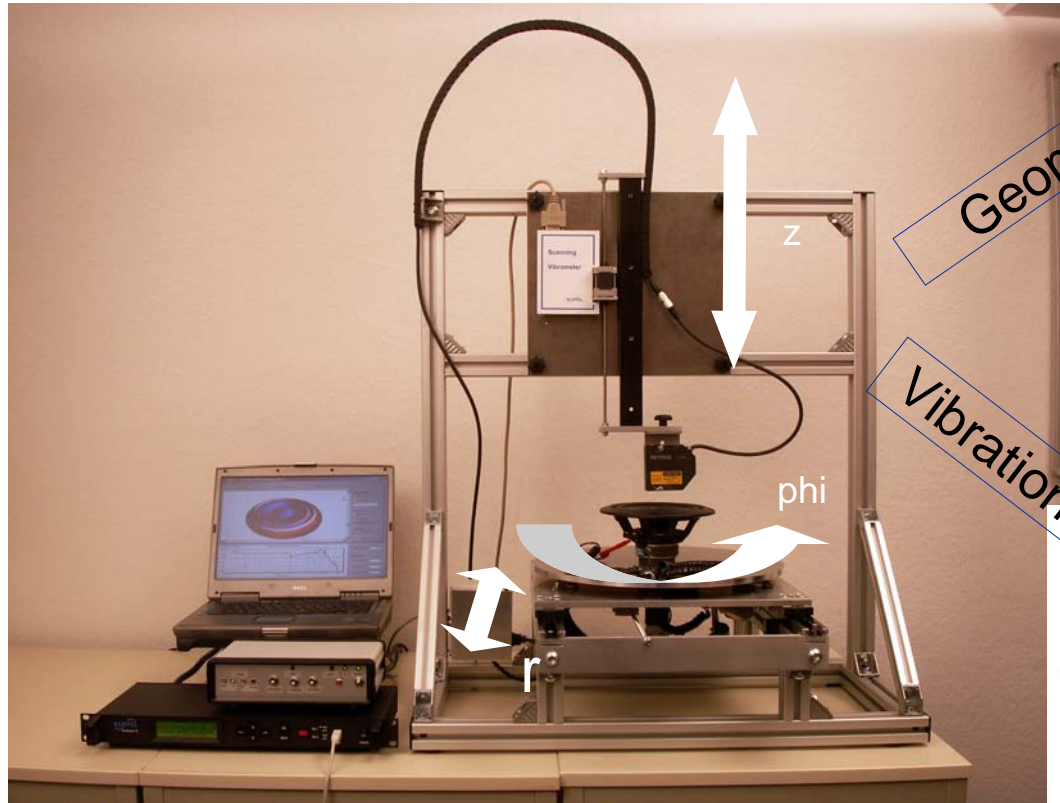
Describing the linear behavior by Transfer functions

脈衝響應 Impulse response



Scanning System

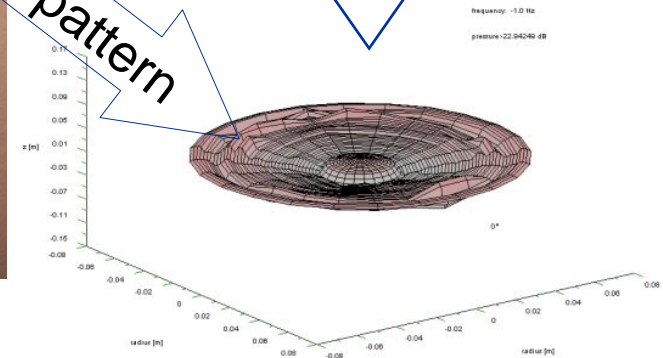
揚聲器振動系幾何形狀與分裂運動的檢視設備 for geometry and vibration of loudspeaker parts



Geometry

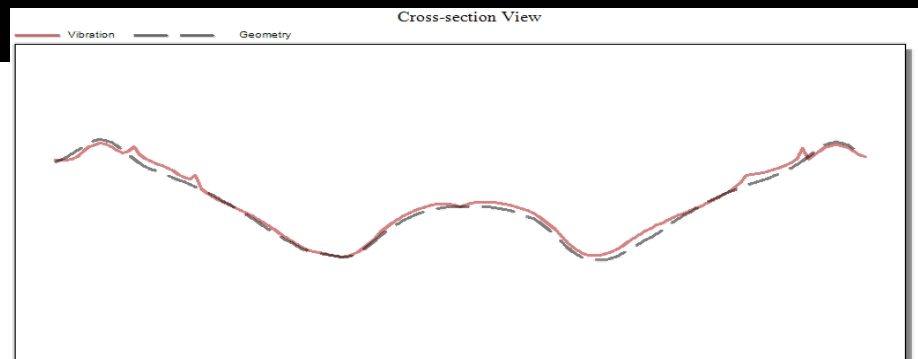
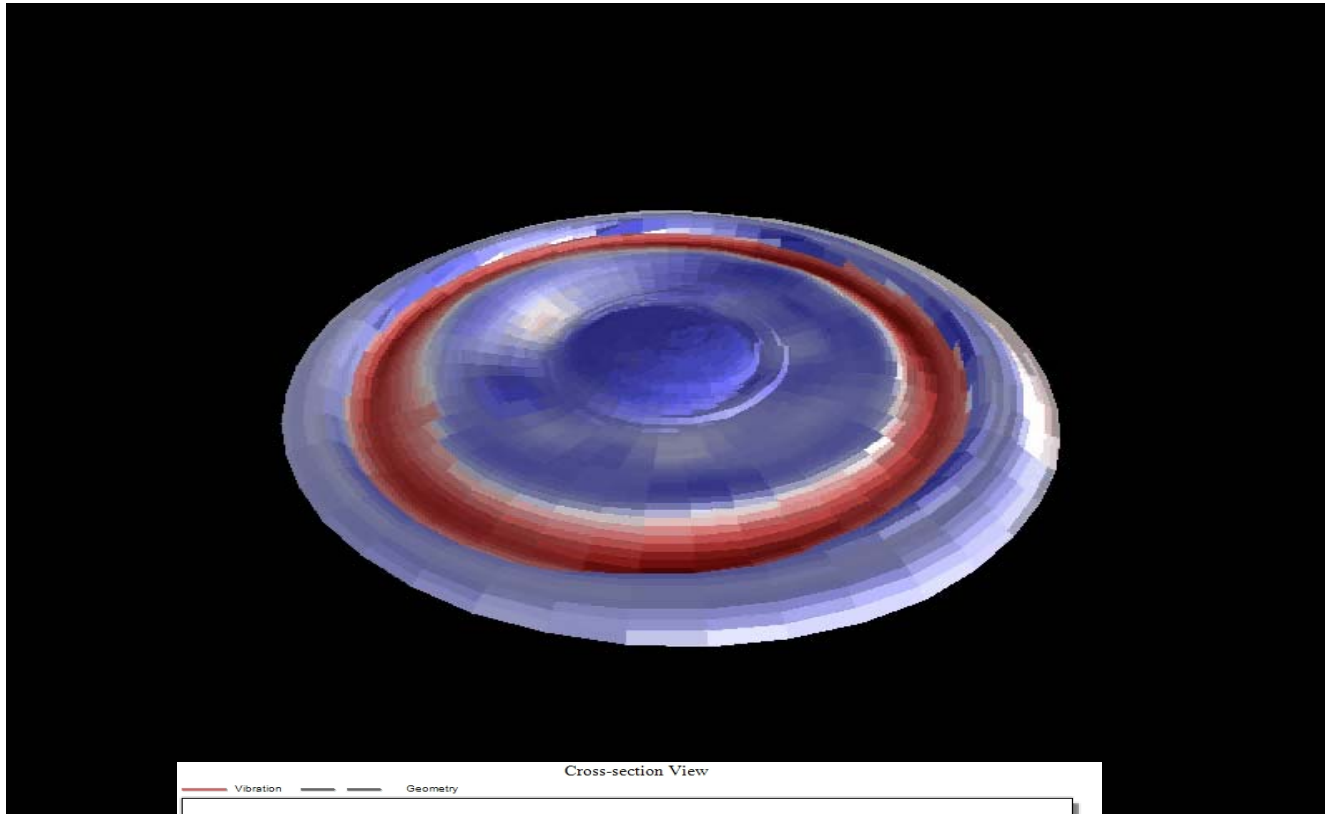
Compare

Vibration pattern



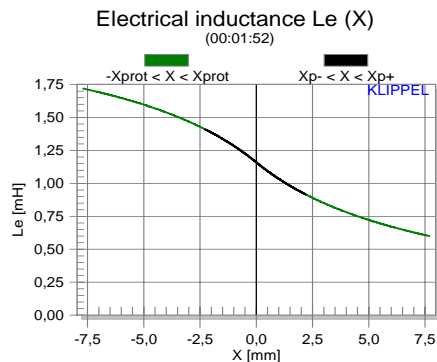
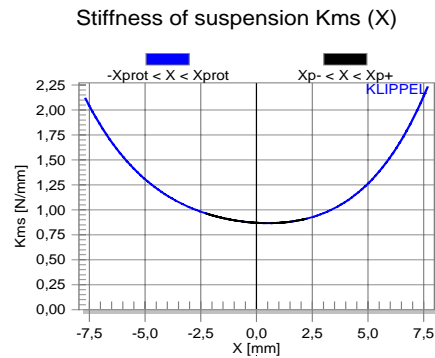
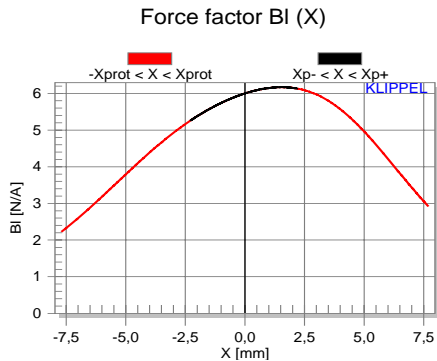
Vibration at 3046 Hz

再高一些頻率



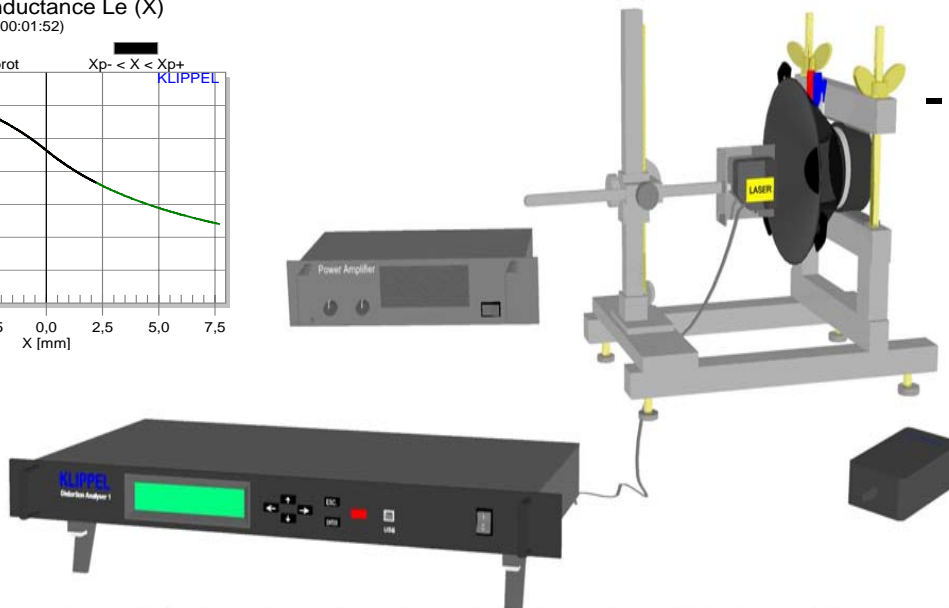
大信號參數測量 LSI

Large Signal Identification



結果 Results:

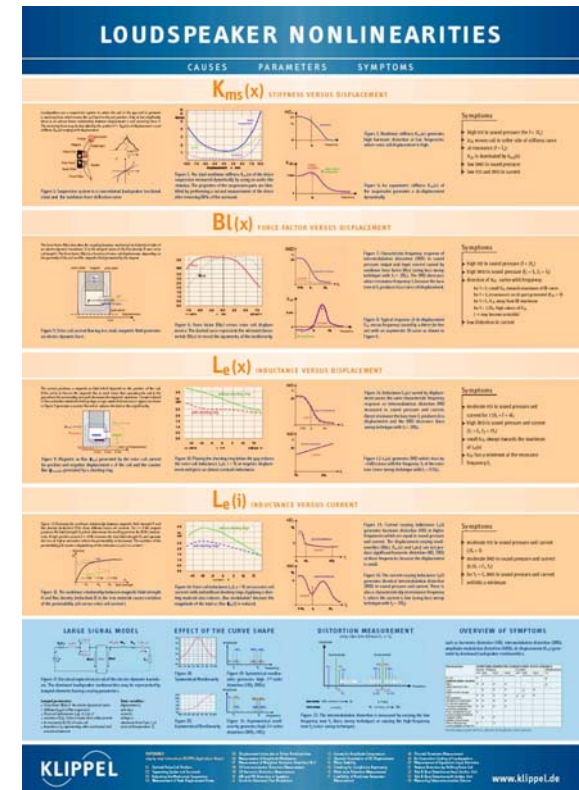
- 非線性參數
Nonlinear Parameter
- 最大振幅極限
Displacement Limits
- 溫昇散熱參數
Thermal Parameter



非線性及失真的關連 - DIS

Relationship between Nonlinearity and Distortion

1. A set of meaningful and comprehensive distortion measurements
2. Simple interpretation of the results
3. Synthesis of desired transfer behavior



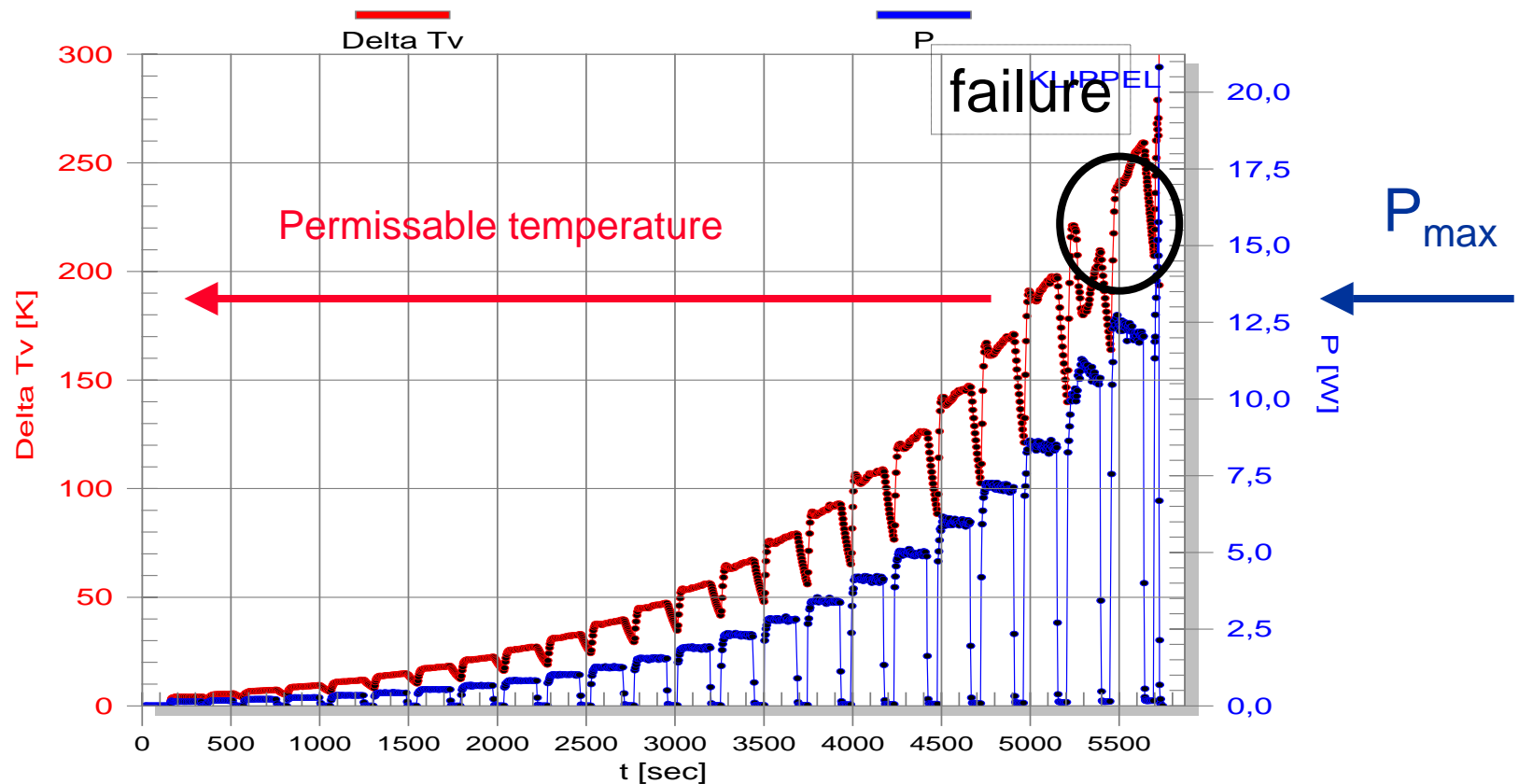
Detailed Description → JAES 10/06 Tutorial Paper:
„Loudspeaker Nonlinearities – Causes, Parameters, Symptoms,“



評估可承受功率 PWT

Assessing Power Handling

Increase of voice coil temperature $\Delta T_v(t)$ and electrical input power $P(t)$
DUT: 1 (01:35:54)



參數變化 Parameter Variation - PWT

研究環境溫溼度變化對參數的影響

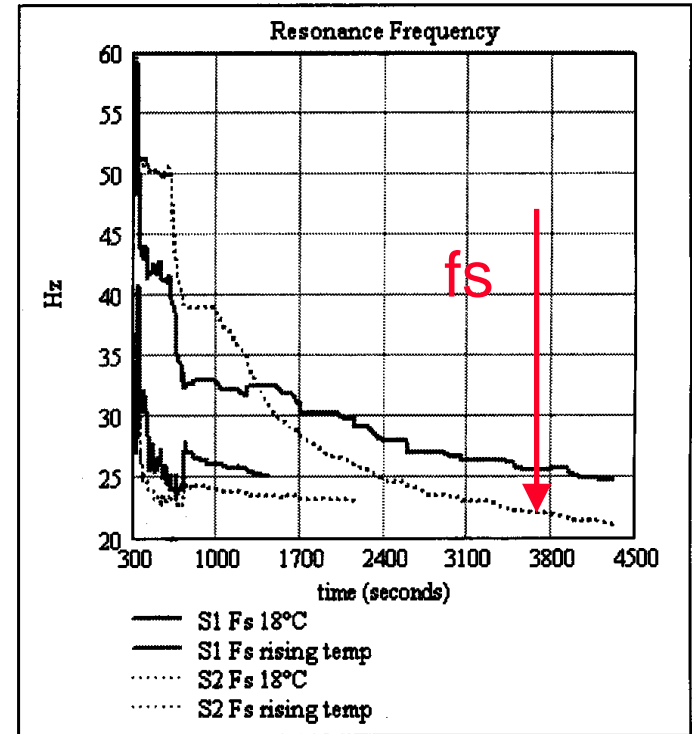
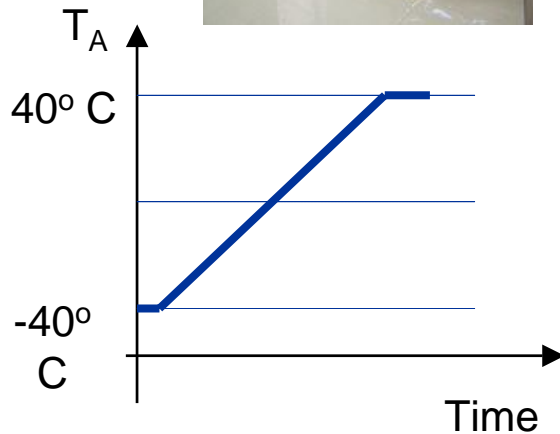
Investigate the Influence of Ambience Conditions

恆溫恆濕箱
chamber



„深圳“

„哈爾濱“



→ S. Hutt: Ambient Temperature Influences on OEM Automotive Loudspeakers, AES preprint 5507

KLIPPEL可測的 IEC 國際標準 60268 –5項目 measured by KLIPPEL

Characteristics to be specified	KLIPPEL Module	Template	AN
16.1 Rated Impedance	LPM, TRF		
16.2 Impedance Curve	LPM, TRF		
16.3 Total Q-factor	LPM		
16.4 Equivalent Air volume (Vas)	LPM		
17.1 Rated Noise Voltage	PWT	PWT IEC17.1 Rated voltage	
17.2 Short term maximum input voltage	PWT	PWT IEC17.2 Short voltage	
17.3 Long term maximum input voltage	PWT	PWT IEC17.3 Long voltage	
17.4 Rated sinusoidal Voltage	PWT	PWT IEC17.4 Sinus voltage	
18.1 Rated Noise power	PWT	PWT IEC17.1 Rated voltage	
18.2 Short term maximum input power	PWT	PWT IEC17.2 Short voltage	
18.3 Long term maximum input power	PWT	PWT IEC17.3 Long voltage	
18.4 Rated sinusoidal power	PWT	PWT IEC17.4 Sinus voltage	
19.1 Rated frequency range	TRF		
19.2 Resonance frequency	TRF, LPM		
19.3 Tuning Frequency	TRF, LPM		
20.2 Sound- pressure in a stated frequency band	TRF	TRF IEC 20.2 SPL 1/3 oct.	
20.6 Mean SPL in a stated band	TRF+ MAT		
21.1 Frequency response	TRF, DIS		
21.2 Effective frequency range	TRF+MAT		
21.3 Transfer Function	TRF, DIS		
22.4 Mean efficiency in a frequency band	TRF+MAT		
23 Directional characteristics	TRF+MAT		
24.2 Total harmonic distortion	TRF, DIS	DIS IEC 24.2 THD	9
24.2.3 2 nd and 3 rd -order Harmonics (step-by-step)	DIS		
24.3.2 2 nd and 3 rd -order Harmonics (gliding tones)	TRF		
24.4. Characteristic Harmonic Distortion (referred to 1/3 octave band)	TRF+MAT		
24.5 Modulation distortion	DIS	DIS IEC 24.5 MD	
24.6. Characteristic Modulation Distortion (referred to sound pressure in stated band 20.2)	TRF+MAT		
24.7 Difference frequency distortion	DIS+MAT	DIS IEC 24.7 DFD	



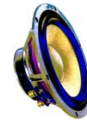
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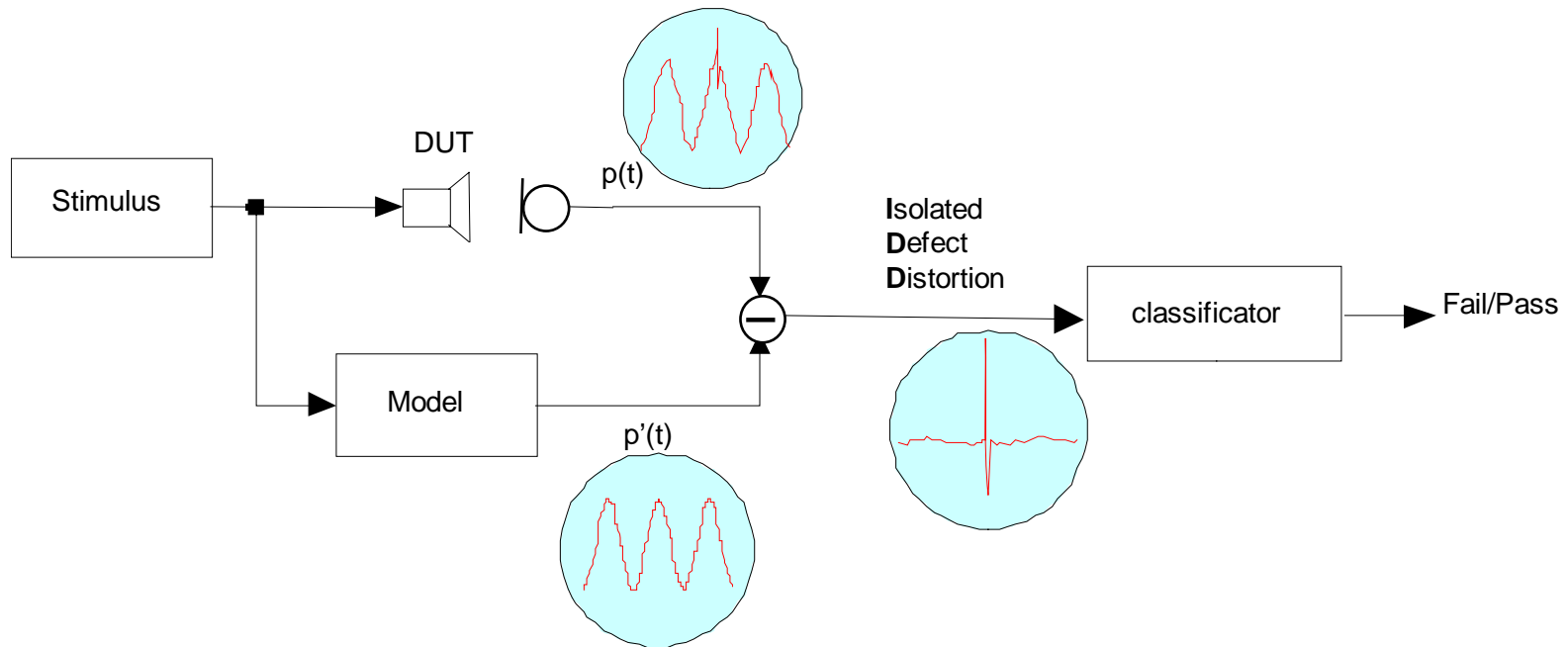
Requirements for 100 % end-of-line testing 線上品管需求

1. reliable detection of defect units 高信賴的不良品檢
2. robustness against ambient noise 自動環境噪音修正
3. high speed 快速執行
4. flexibility for customer's needs 客製化設計
5. simple use 操作簡易
6. cost effective solutions 經濟實惠
7. *In future → on line diagnostics ? 未來可作線上診斷*



可檢測人耳難分辨的缺陷

Detecting Defect Units with inaudible symptoms



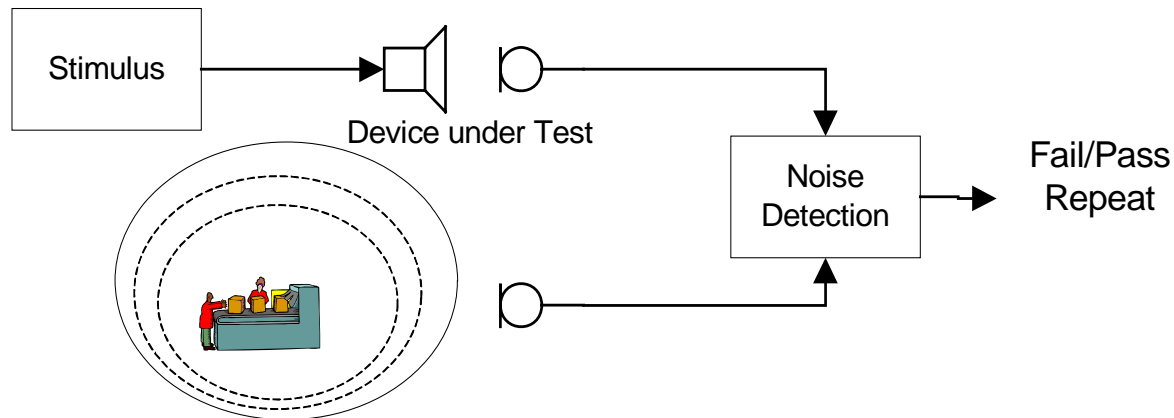
Meta-Hearing Technology

- Regular distortion are predictable
- Modeling of regular distortion (adaptive learning)
- Masking by regular distortion can be removed actively



在吵雜的生產環境做可靠性高的測試

Reliable Measurement in a noisy production environment



Solution:

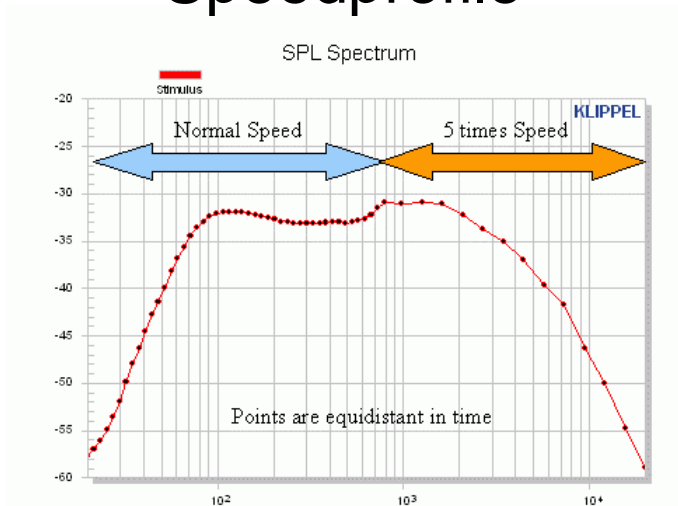
- 第二支麥克風測遠場噪音 Second microphone in the far field
- 預測在待測物的噪音 Predict noise at DUT
- 有效得知測量是否被環境噪音干擾 Detects corrupted measurements reliably
- 自動重複測試 Repeats measurement automatically



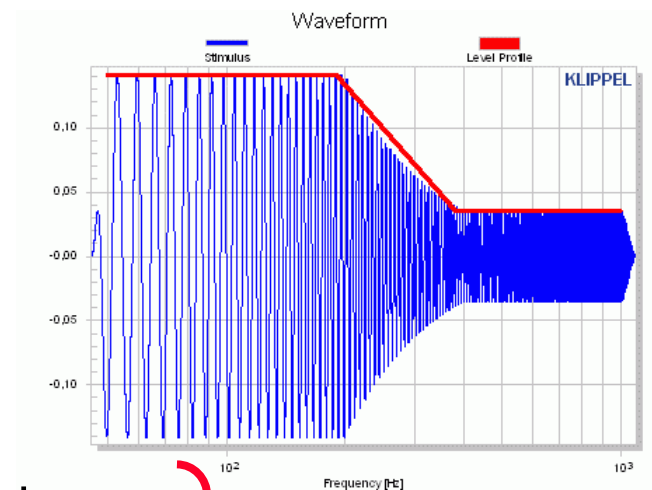
Using very short test signals (<0.5s)

High Speed Performance

Speedprofile



Levelprofile



Benefits:

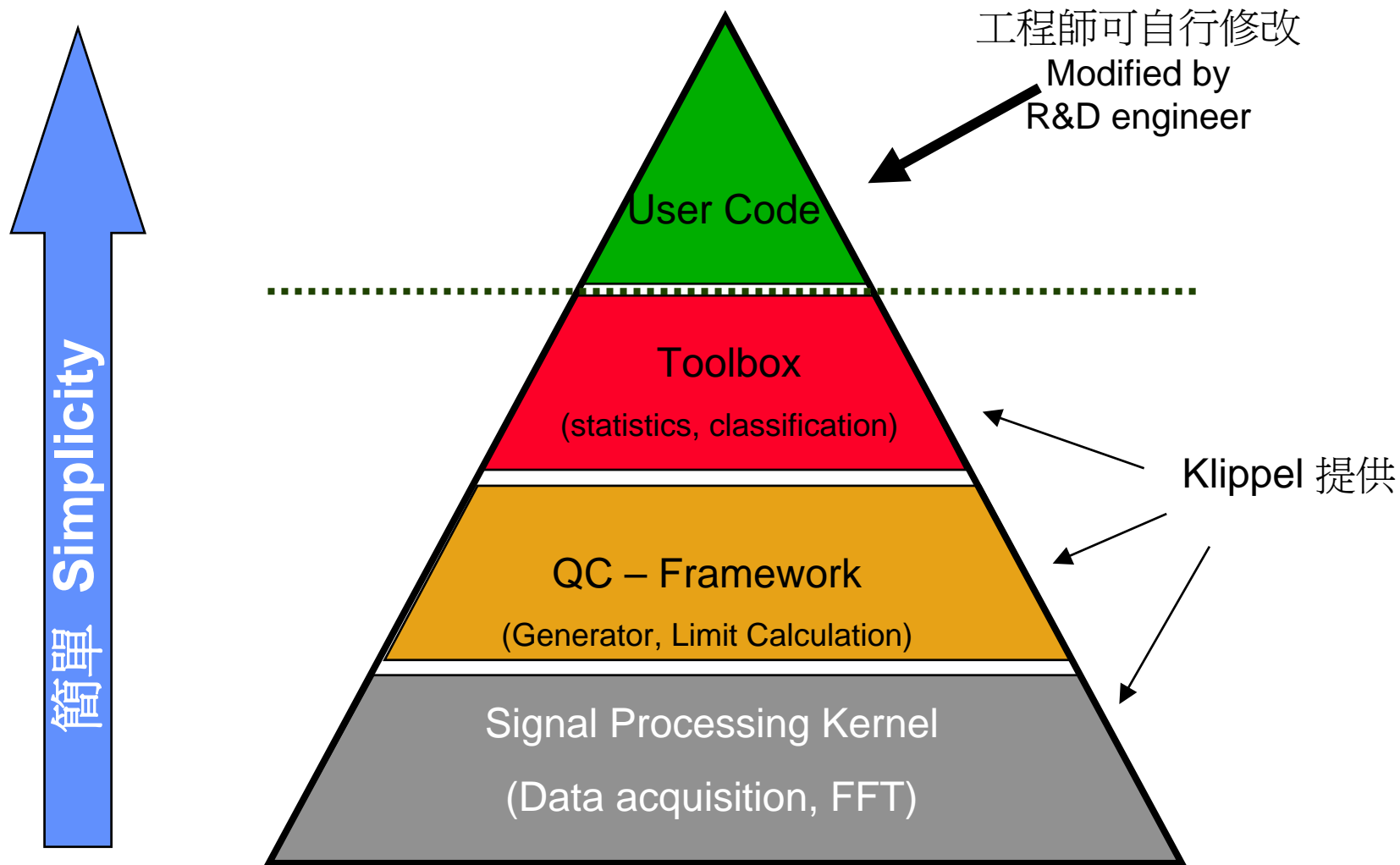
- Provide sufficient energy into critical bands
- Give sufficient time to establish critical vibration
- Protect driver at low frequencies
- Protect operator at high frequencies

Save time

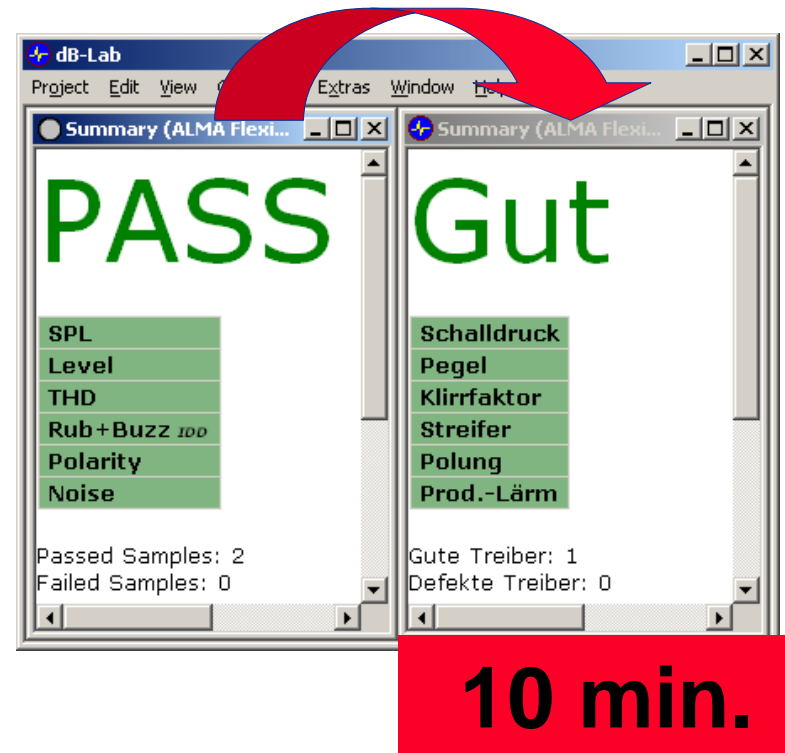
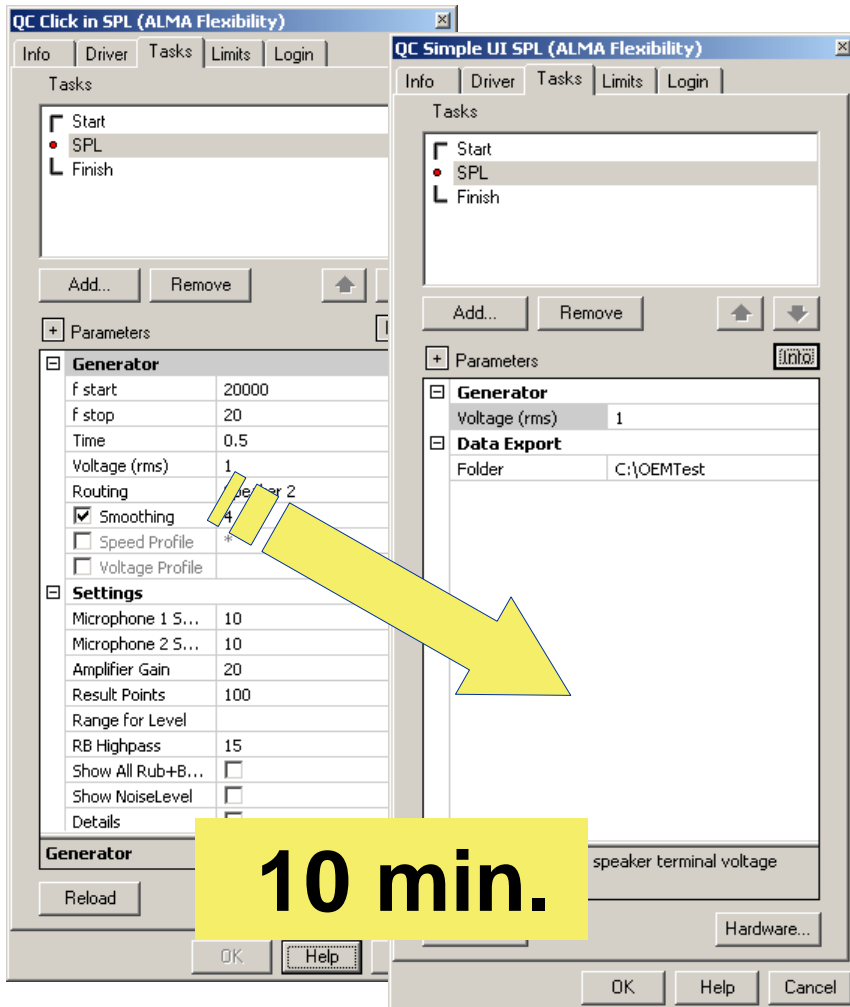


保持程序簡單

Keep Programming simple

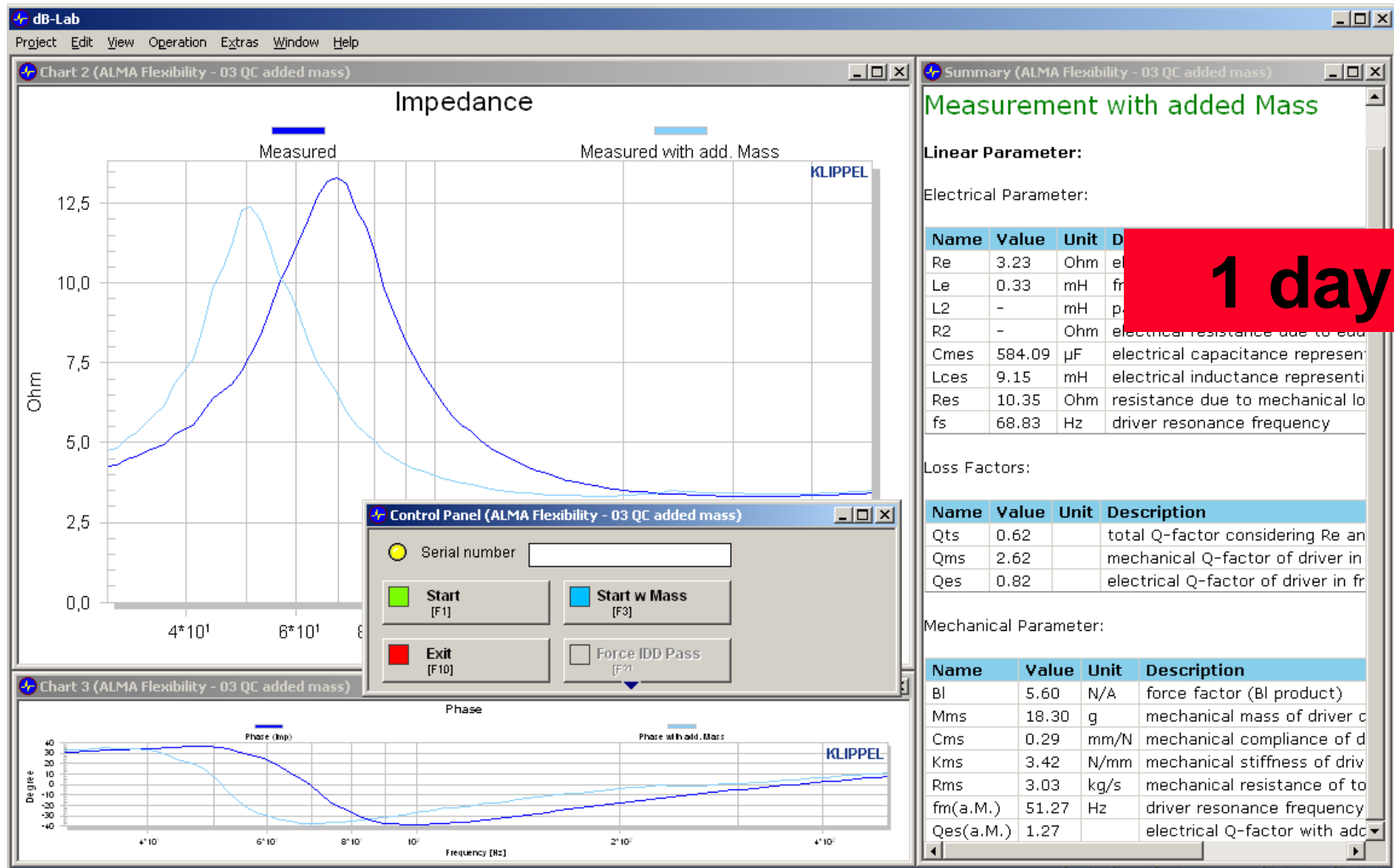


可調整使用者介面, 可漢化 User-Interface can be adjusted



實現客戶特製測試程序

Implement specific algorithms



1 day

→ Code can be protected

After Sales Service

售後服務

www.klippel.de 中國代表意富公司

or

info@klippel.de

- Download Software (free viewer) 一年免費軟體升級
- Get Know-How (applications notes, papers, ...) 應用注釋, 論文
- Discuss Solutions (email or phone) 電郵電話聯繫

